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ARL 62-415  
SUPPLEMENT III

A PORTABLE LOW-LEVEL LIGHTMETER  
III: TRANSISTORIZED DC TO DC POWER CONVERTER

MYRON H. YANG

SOLID STATE PHYSICS RESEARCH LABORATORY

AUGUST 1962

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AUGUST 1962

PROJECT 7072  
TASK 70827

AERONAUTICAL RESEARCH LABORATORIES  
OFFICE OF AEROSPACE RESEARCH  
UNITED STATES AIR FORCE  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

## FOREWORD

This technical documentary report was prepared by Mr. Myron H. Yang of the Solid State Physics Research Laboratory, Aeronautical Research Laboratories, Office of Aerospace Research, United States Air Force. The work reported herein was performed on Task 70827, "Light Amplification" of Project 7072, "Research on the Quantum Nature of Light".

The author desires to express his appreciation to Mr. R. J. H. Gebel group leader of the Optoelectronic Section of ARL for many helpful criticisms and suggestions provided throughout the work performance.

## Abstract

A modification for the power supply unit for the low-level light meter, ARL 62-415, was made by replacing the conventional relay-type vibrator with power transistors.

Advantages in power consumption and reliability of this modification are discussed.

# *A Portable Low-Level Lightmeter Supplement III: Transistorized D C to D C Power Converter*

Myron H. Yang

When operated at high altitudes the low-level lightmeter readings may be defective due to possible mechanical failure of the relay-type vibrator (or nonsynchronous interruptor) in the power supply unit. Therefore, replacing the relay-type vibrator with a nonmechanical device is desirable.

The interruptor is generally used to convert direct current into alternating current. A vibrating reed interrupts the dc, changing it into pulses which are sent through a step-up transformer. The output of the transformer is a high-voltage ac which may be converted back to a high-voltage dc by feeding it through a series of germanium diodes. The 6-volts dc from the battery in the power supply unit is converted to 620-volt dc.

Therefore, if the pulses needed to drive the transformer could be generated by some electrical means, the interruptor and its possible mechanical failures might then be eliminated. We found that a pair of power transistors connected in a push-pull circuit were able to produce the desired pulses. These pulses are sinusoidal and may be used efficiently to drive the transformer. This transistorized converter is in turn driven by the feedback voltage from the same transformer resulting in an oscillating circuit. The transistorized converter, containing two power transistors of the Honeywell XH10FC type and only the necessary capacitors and resistors, replaces the relay-type vibrator, VB 7. The electrical circuit of the modified power supply is shown in Figure 1, the original power supply before the alteration is shown in Figure 2a, and a physical comparison of the old and new vibrators in Figure 2b.

The transistor circuit has a frequency of about 80 cps compared with the vibrating reed's frequency of about 100 cps. Both give about 620 volts dc at the output of the 10 germanium diodes, 1N39, in series. The mechanical interruptor drew a total of 4.60 amp dc and 2.38 amp of it through the transformer. Now the transistorized converter draws 2.30 amp dc in total and 1.20 amp dc through the transformer. As can be seen by inspection, the current consumed by the transistorized converter is almost half of that required for the interruptor. Likewise, the power consumption is also halved. In some applications low-power consumption may play a very important factor, so the advantage gained by transistorized converter may be helpful in military as well as in industrial applications. The transistorized converter has no moving parts; consequently, it is free from mechanical failure. Moreover, the transistorized converter output has high reliability, since it has no point contacts which usually cause missing or sticking. This difference may be seen from the wave forms of each vibrator. The transistorized converter has a much more stable and smoother wave form. Also, the ruggedness of transistors is high compared with the mechanical interruptor and the lifetime is indefinitely lengthened.

The transistors are mounted on an aluminum frame which serves as a heat-dissipation sink. The construction of the frame is shown in Figure 3. This frame will heat up to 45° C at a room temperature of 26° C. Compared with the mechanical interruptor, the transistorized converter is completely free of annoying mechanical noise.

The results of the test on the substitution of the transistorized converter for the mechanical interruptor in the power supply unit for the low-level lightmeter were completely satisfactory.



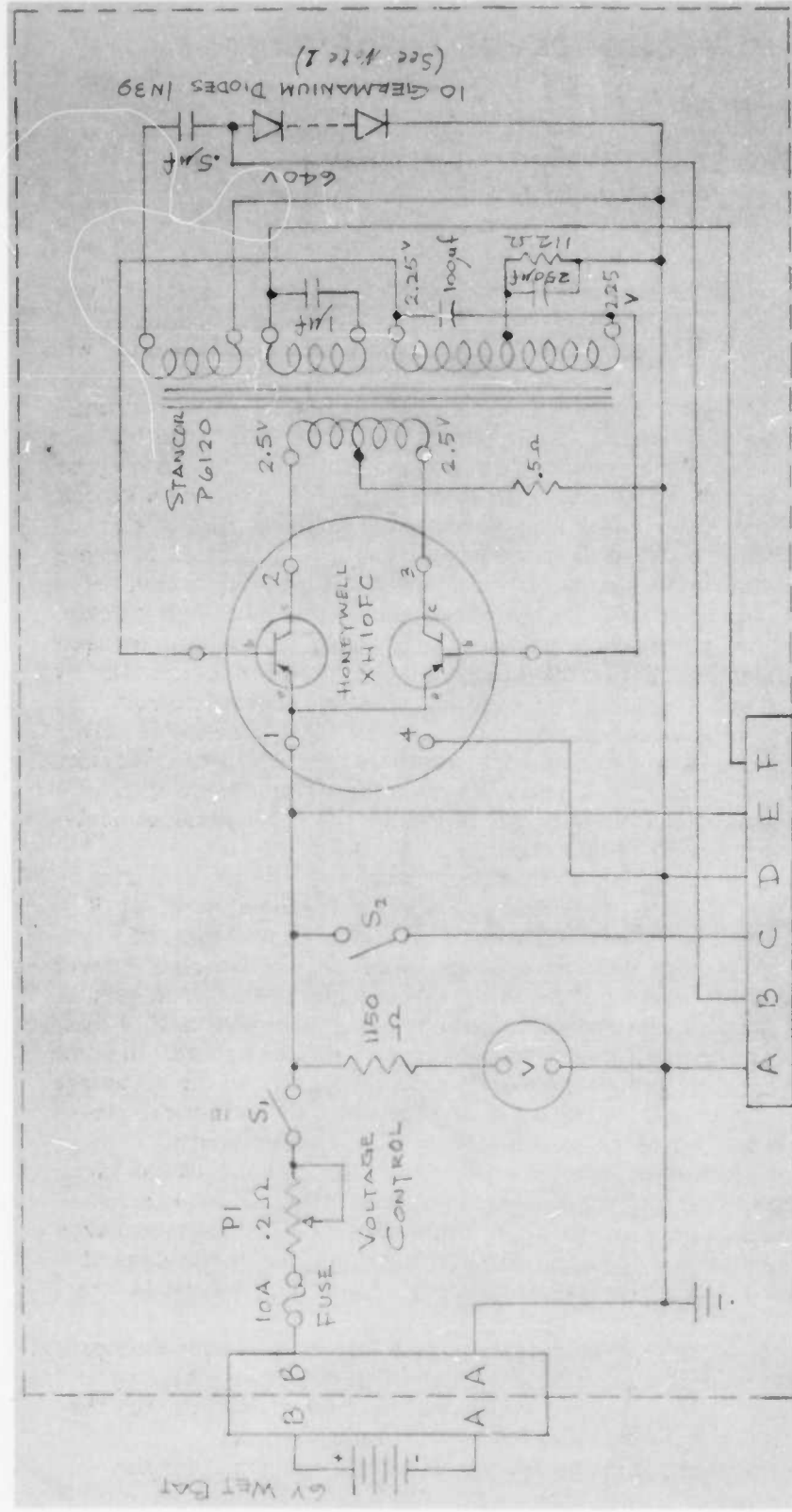
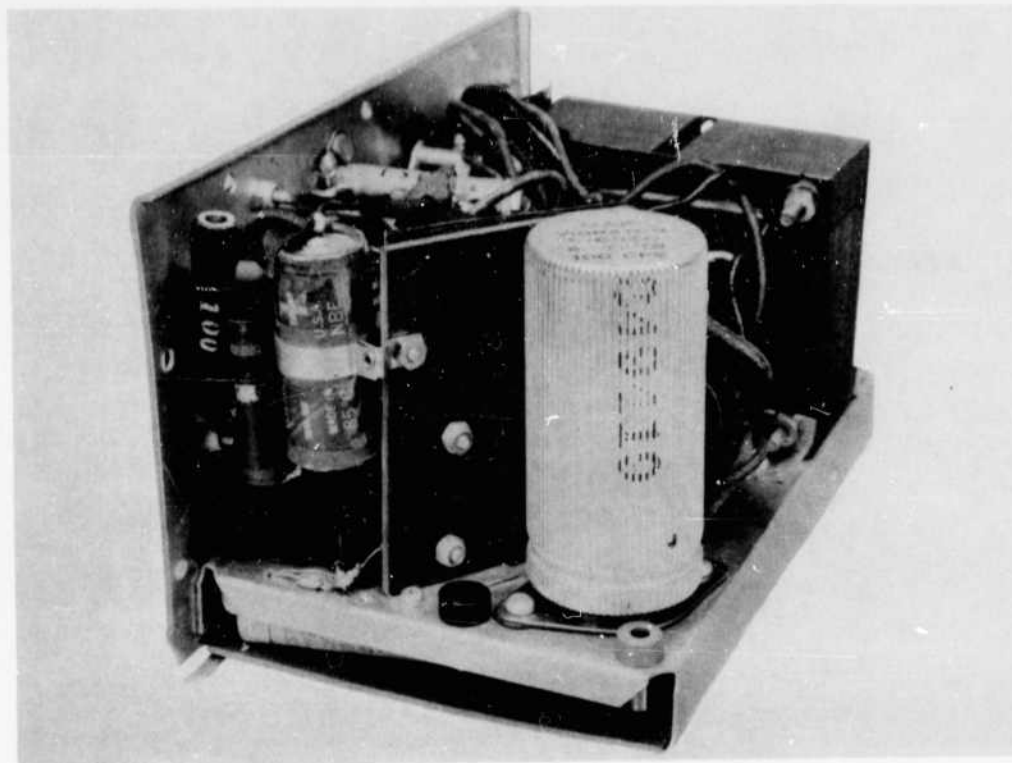


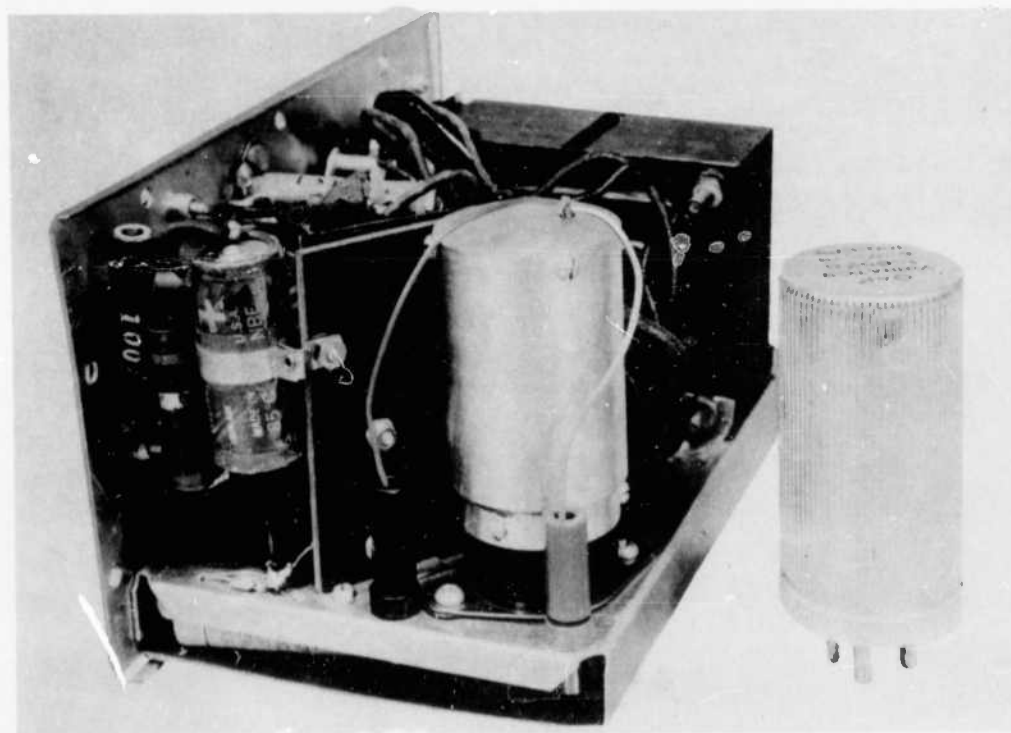
Figure 1. Power Supply Unit Circuit Diagram

#### NOTE 1

When using germanium or silicon diodes for rectification or voltage doubling, careful matching for back resistance must be used. If proper matching is achieved, the number of diodes in series may be reduced. Maximum reverse working voltage for 1N39 is 200 volt dc.



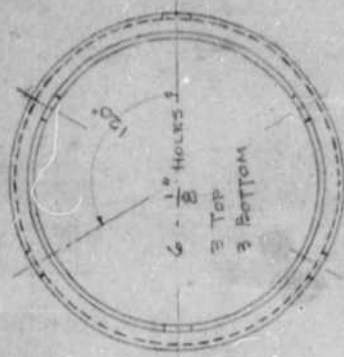
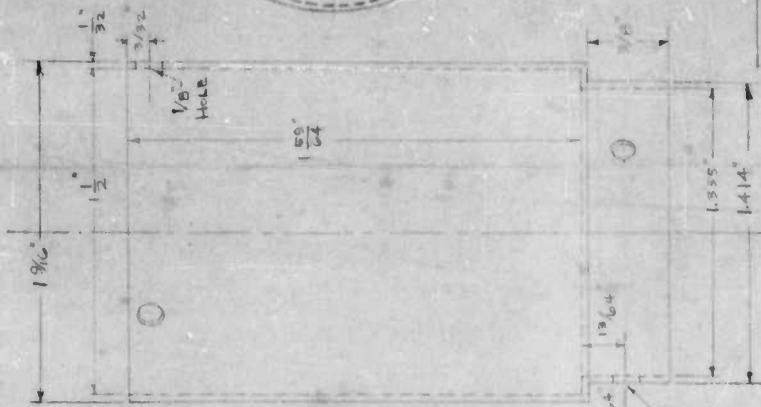
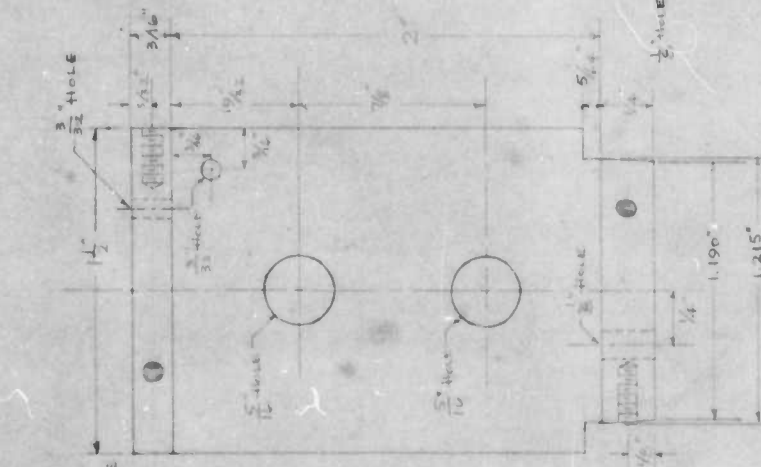
*Figure 2a. Power Supply Unit with Relay Type Vibrator*



*Figure 2b. Power Supply Unit with Transistorized Vibrator*

## MOUNTING FRAME

## II CASING



BOTTOM VIEW

SCALE. 2" = 1"

TRANSISTORIZED CONVERTER  
for

## LOW LEVEL LIGHTMETER

AERO. RES. LABS. ENG. PHY. BRANCH  
TASK NO. 70827

WPAFB Dayton Ohio

FIG 3 FRAME CONSTRUCTION

<p>Aeronautical Research Laboratories, Wright-Patterson AFB, Ohio. A PORTABLE LOW-LEVEL LIGHTMETER: III TRANSISTORIZED DC TO DC POWER CONVERTER by R.K.H. Gebel, Solid State Physics Research Laboratory. August 1962. 4 p. incl. illus. (Project 7072; Task 70827) (ARL 62-415, III)</p> <p>Unclassified Report</p> <p>A modification for the power supply unit for the low-level lightmeter, ARL 62-415, was made by replacing the conventional relay-type vibrator with power transistors. Advantage in power consumption and reliability oo</p> <p>( over )</p>	<p>UNCLASSIFIED</p>	<p>Aeronautical Research Laboratories, Wright-Patterson AFB, Ohio. A PORTABLE LOW-LEVEL LIGHTMETER: III TRANSISTORIZED DC TO DC POWER CONVERTER by R.K.H. Gebel, Solid State Physics Research Laboratory. August 1962. 4 p. incl. illus. (Project 7072; Task 70827) (ARL 62-415, III)</p> <p>Unclassified Report</p> <p>A modification for the power supply unit for the low-level lightmeter, ARL 62-415, was made by replacing the conventional relay-type vibrator with power transistors. Advantage in power consumption and reliability oo</p> <p>( over )</p>	<p>UNCLASSIFIED</p>
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